National Semiconductor

LM2991
Negative Low Dropout Adjustable Regulator

General Description

The LM2991 is a low dropout adjustable negative regulator with a output voltage range between −3V to −24V. The LM2991 provides up to 1A of load current and features a $\overline{\text{On}}$/Off pin for remote shutdown capability.

The LM2991 uses new circuit design techniques to provide a low dropout voltage, low quiescent current and low temperature coefficient precision reference. The dropout voltage at 1A load current is typically 0.6V and a guaranteed worst-case maximum of 1V over the entire operating temperature range. The quiescent current is typically 1 mA with a 1A load current and an input-output voltage differential greater than 3V. A unique circuit design of the internal bias supply limits the quiescent current to only 9 mA (typical) when the regulator is in the dropout mode ($V_{OUT} - V_{IN} \leq 3V$).

The LM2991 is short-circuit proof, and thermal shutdown includes hysteresis to enhance the reliability of the device when inadvertently overloaded for extended periods. The LM2991 is available in 5-lead TO-220 and TO-263 packages and is rated for operation over the automotive temperature range of −40˚C to +125˚C. Mil-Aero versions are also available.

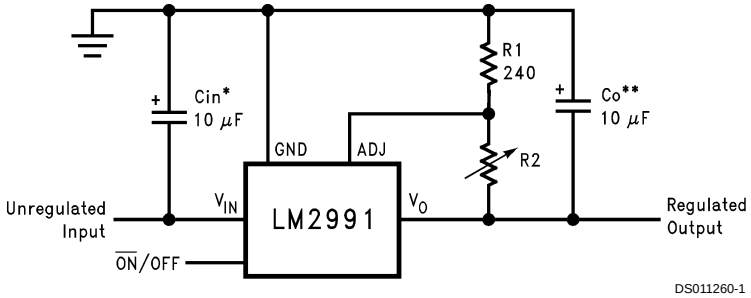
Features

- Output voltage adjustable from −3V to −24V, typically −2V to −25V
- Output current in excess of 1A
- Dropout voltage typically 0.6V at 1A load
- Low quiescent current
- Internal short circuit current limit
- Internal thermal shutdown with hysteresis
- TTL, CMOS compatible $\overline{\text{ON}}$/OFF switch
- Functional complement to the LM2941 series

Applications

- Post switcher regulator
- Local, on-card, regulation
- Battery operated equipment

Typical Application



$V_{OUT} = V_{REF} (1 + R2/R1)$

*Required if the regulator is located further than 6 inches from the power supply filter capacitors. A 1 µF solid tantalum or a 10 µF aluminum electrolytic capacitor is recommended.

**Required for stability. Must be at least a 10 µF aluminum electrolytic or a 1 µF solid tantalum to maintain stability. May be increased without bound to maintain regulation during transients. Locate the capacitor as close as possible to the regulator. The equivalent series resistance (ESR) is critical, and should be less than 10Ω over the same operating temperature range as the regulator.

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

Input Voltage	−26V to +0.3V
ESD Susceptibility (Note 2)	2 kV
Power Dissipation (Note 3)	Internally limited
Junction Temperature (T_{Jmax})	125˚C
Storage Temperature Range	−65˚C to +150˚C
Lead Temperature (Soldering, 10 sec.)	230˚C

Operating Ratings (Note 1)

Junction Temperature Range (T_J)	−40˚C to +125˚C
Maximum Input Voltage (Operational)	−26V

Electrical Characteristics

V_{IN} = −10V, V_O = −3V, I_O = 1A, C_O = 47 µF, R1 = 2.7k, T_J = 25˚C, unless otherwise specified. **Boldface** limits apply over the entire operating junction temperature range.

Parameter	Conditions	Typical (Note 4)	Min	Max	Units
Reference Voltage	5 mA ≤ I_O ≤ 1A	−1.210	−1.234	−1.186	V
	5 mA ≤ I_O ≤ 1A, V_O − 1V ≥ V_{IN} ≥ −26V		**−1.27**	**−1.15**	V
Output Voltage		−2		−3	V
Range	V_{IN} = −26V	−25	−24		V
Line Regulation	I_O = 5 mA, V_O − 1V ≥ V_{IN} ≥ −26V	0.004		0.04	%/V
Load Regulation	50 mA ≤ I_O ≤ 1A	0.04		0.4	%
Dropout Voltage	I_O = 0.1A, ΔV_O ≤ 100 mV	0.1		0.2 **0.3**	V
	I_O = 1A, ΔV_O ≤ 100 mV	0.6		0.8 **1**	V
Quiescent Current	I_O ≤ 1A	0.7		**5**	mA
Dropout Quiescent Current	V_{IN} = V_O, I_O ≤ 1A	16		50	mA
Ripple Rejection	V_{ripple} = 1 Vrms, f_{ripple} = 1 kHz, I_O = 5 mA	60	50		dB
Output Noise	10 Hz − 100 kHz, I_O = 5 mA	200		450	µV
$\overline{ON}$ /OFF Input Voltage	(V_{OUT}: ON)	1.2		**0.8**	V
	(V_{OUT}: OFF)	1.3	**2.4**		
$\overline{ON}$ /OFF Input Current	$V_{\overline{ON}/OFF}$ = 0.8V (V_{OUT}: ON)	0.1		10	µA
	$V_{\overline{ON}/OFF}$ = 2.4V (V_{OUT}: OFF)	40		100	
Output Leakage Current	V_{IN} = −26V, $V_{\overline{ON}/OFF}$ = 2.4V, V_{OUT} = 0V	60		250	µA
Current Limit	V_{OUT} = 0V	2	1.5		A

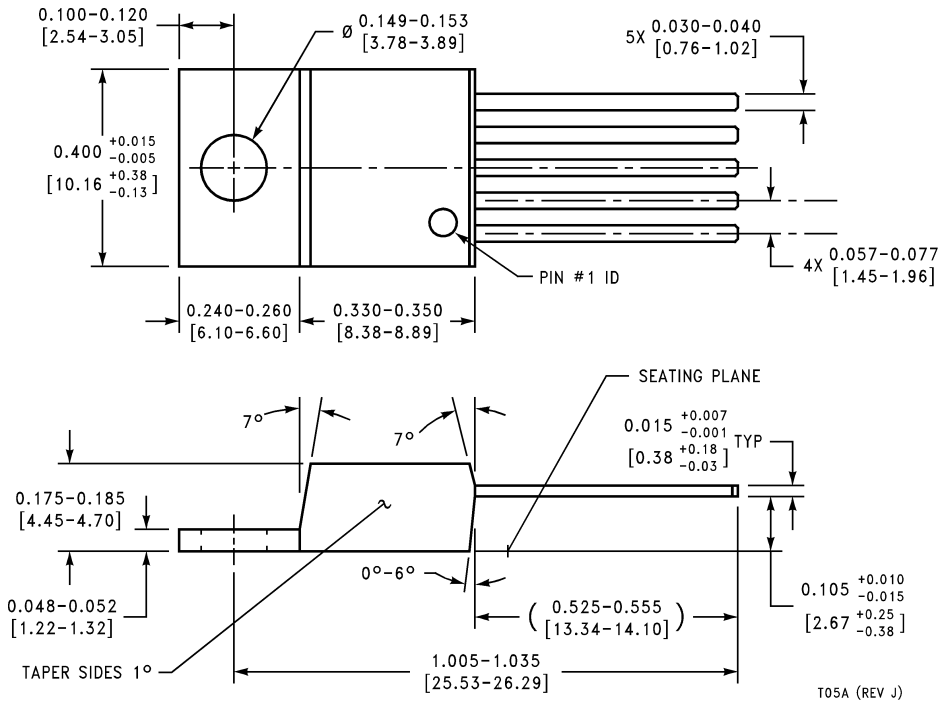
Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the deivce is intended to be functional, but do not guarantee specific performance limits. For guaranteed specifications and test conditions, see the Electrical Characteristics.

Note 2: Human body model, 100 pF discharged through a 1.5 kΩ resistor.

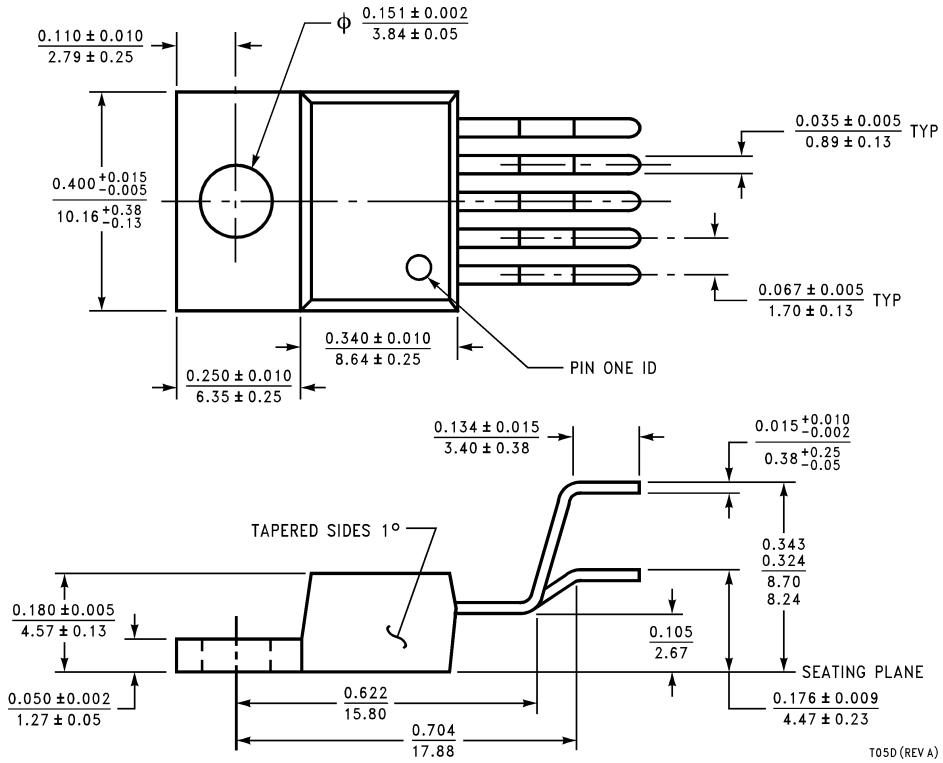
Note 3: The maximum power dissipation is a function of T_{Jmax}, θ_{JA} and T_A. The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{Jmax} - T_A)/\theta_{JA}$. If this dissipation is exceeded, the die temperature will rise above 125˚C and the LM2991 will go into thermal shutdown. For the LM2991, the junction-to-ambient thermal resistance is 53˚C/W for the TO-220, 73˚C/W for the TO-263, and junction-to-case thermal resistance is 3˚C. If the TO-263 package is used, the thermal resistance can be reduced by increasing the PC board copper area thermally connected to the package. Using 0.5 square inches of copper area, θ_{JA} is 50˚C/W; with 1 square inch of copper area, θ_{JA} is 37˚C/W; and with 1.6 or more square inches of copper area, θ_{JA} is 32˚C/W.

Note 4: Typicals are at T_J = 25˚C and represent the most likely parametric norm.

Physical Dimensions inches (millimeters) unless otherwise noted



5-Lead T0-220, Straight Leads (T)
Order Number LM2991T
NS Package Number T05A



5-Lead T0-220, Bent, Staggered Leads (T)
Order Number LM2991T Flow LBO3
NS Package Number T05D